REMARKS

Non-elected method claim 5 is canceled, and new claims 7-19 have been added. The new claims are directed to the elected invention. No new matter was added. Accordingly, claims 1, 2 and 7-19 are pending for prosecution in the present application. Applicant submits arguments and Terminal Disclaimers for overcoming the rejections over the prior art of record. Therefore, Applicant respectfully submits that the present application is in condition for allowance.

I. Claim Rejections - 35 USC §103(a)

A. In the non-final Office Action of September 15, 2008, claims 1 and 2 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo.

(i) Background

The cited prior art reference, U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo, corresponds to U.S. Patent No. 6,861,030 B2 issued to Shindo (which was cited in Applicant's previously filed Information Disclosure Statement). Yuichiro Shindo, the inventor of the present application, is the inventor of the invention disclosed in the cited application publication and above referenced issued patent. Nippon Mining and Manufacturing Co., Ltd. is the assignee of the present application and the cited reference. Accordingly, Applicant is well aware of the cited reference and its disclosure.

The present application discloses an advancement of the art over that disclosed in Applicant's earlier filing. Applicant respectfully submits that the '261 Shindo application publication (or the '030 Shindo patent) fails to disclose the present invention and fails to render the present invention obvious. The refining of high purity hafnium in the cited reference is different than that of the present invention, and the awareness of the importance of the presence

of zirconium and oxygen in the high purity hafnium is distinctly different. It should be understood that high purification of hafnium with respect to zirconium and oxygen content is complicated and extremely difficult to achieve and should not be considered trivial or obvious. In addition, Applicant respectfully submits that the significance of the advancement provided by the present application should not be overlooked.

(ii) The '261 Application Publication/'030 Patent of Shindo

The cited reference discloses hafnium of a 4N (99.99%) purity. This purity specifically excludes zirconium and gas components (such as oxygen, carbon and nitrogen) as impurities in determination of the stated purity level. For example, see column 9, lines 2-4, of the '030 Shindo patent and corresponding Paragraph No. 0090 of the '261 Shindo published application. This is conventional practice with respect to the purity of hafnium.

It should also be noted that the cited reference fails to disclose a refining step of subjecting an ingot to deoxidation with molten salt which makes possible the reduction of oxygen to 40wtppm or less required by the claims of the present application. (For example, see page 5, lines 21-26, of the present application, as filed.)

With respect to oxygen content, the cited reference discloses the following:

> "Although it is difficult to reduce the content of gas components such as oxygen and carbon, it is still possible to obtain high-purity zirconium having a content of gas components considerably lower in comparison to the raw material, that is to be less than 1000ppm." (See column 6, lines 28-32, of the '030 Shindo patent and Paragraph No. 0063 of the '261 Shindo published application.)

Of course, the same holds true for hafnium which is an element that has a strong bond with oxygen and thereby makes the reduction of oxygen extremely difficult. In this regard, the cited reference states with respect to hafnium that: "Here, the content of gas components such as

oxygen and carbon can be reduced to 500ppm or less." See column 6, lines 41-43, of the '030 Shindo patent and Paragraph No. 0064 of the '261 Application Publication of Shindo.

More specifically, column 2, line 20; column 8, Table 3; and column 12, Table 3 of the '030 Shindo patent each discloses a hafnium raw material having 500wtppm of oxygen. (This corresponds to Paragraph Nos. 0016, 0088 and 0126 of the '261 Shindo published application.)

After electron beam furnace melting, the hafnium material has an oxygen content of 120wtppm. See column 8, Table 4, and column 9, lines 14-18, of the '030 Shindo patent and Paragraph Nos. 0089 and 0092 of the '261 Shindo published application.

Further, the '030 Shindo patent states that "the content of gas components such as oxygen and carbon is 500ppm or less". See column 3, lines 44-45; column 4, lines 27-28; and claims 11-14. This corresponds to Paragraph Nos. 0030 and 0039 and claims 6 and 14 of the '261 Shindo published application.

With respect to zirconium content, the cited reference discloses the following:

> " ... a large quantity of zirconium is contained in hafnium, and notwithstanding the fact that the separation and refinement between the two is difficult, this may be ***disregarded*** since the purpose of use of the respective materials ***will not hinder*** overall purpose hereof" (see column 6, lines 12-16, of the '030 Shindo patent and Paragraph No. 0061 of the '261 Shindo published application); and
>
> "It is ***extremely difficult to reduce Zr*** in high purity hafnium ... the fact that Zr is mixed in high-purity hafnium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem***. " (See column 6, lines 44-48, of the '030 Shindo patent and Paragraph No. 0065 of the '261 Shindo published application)"

The cited reference teaches that raw material hafnium will have about 25000wtppm of zirconium. See column 8, Table 3, and column 12, Table 3 of the '030 Shindo patent, and see Paragraph Nos. 0088 and 0126 of the '261 Shindo published application.

The cited reference teaches that the hafnium can be refined such that zirconium content is reduced to 3500wtppm or 2400wtppm (0.24wt%). See column 8, Table 4; column 9, lines 35-38; and column 13, Table 4 of the '030 Shindo patent, and see Paragraph Nos. 0089, 0095 and 0131 of the '261 Shindo published application.

Further, the cited reference states that "the content of Zr is 0.5wt% or less". See column 3, line 49; column 4, lines 31-32; column 6, lines 44-48; and claims 15-20 of the '030 Shindo patent, and see Paragraph Nos. 0031, 0040 and 0065 and claims 7, 15 and 26 of the '261 Shindo published application.

(iii) Reasons for Patentability of the Present Invention

Applicant respectfully submits the following reasons for the patentability of the claims of the present application over the '030 Shindo patent/'261 Shindo published application:

(a) the disclosure provided by the cited reference has been misinterpreted with respect to oxygen content;

(b) the cited reference fails to disclose the reduced oxygen content required by the claims of the present application or the need for such reduction and fails to disclose deoxidation with molten salt required for the reduction; and

(c) the cited reference fails to disclose the zirconium content required by the claims of the present application or the need for such reduction.

(a)/(b) Oxygen Content

In the Office Action dated September 15, 2008, the cited reference is interpreted as follows:

"Oxygen and carbon would be present at levels less than 100ppm ... (claim 4)".

Applicant respectfully submits that this is a mistake. Throughout the '030 Shindo patent and the corresponding '261 Shindo published application, the purity level of the hafnium material is always determined by excluding zirconium and gas components (such as oxygen, carbon and nitrogen) as impurities. This is conventional practice. Claim 4 of the '261 Shindo published application is no exception. Claim 4 of the '261 Shindo published application requires:

> "... the content of impurities excluding Zr and gas components such as oxygen and carbon is less than 100ppm."

A proper interpretation of the above referenced statement is that the "content of impurities" in the hafnium material is less than 100ppm; however, this specifically excludes zirconium and gas components from consideration as impurities. Of course, by gas components, claims 4 of the '261 Shindo published application refers specifically to oxygen and carbon. Thus, this claim does not disclose that oxygen would be present at levels of less than 100ppm; rather, it simply discloses that oxygen is excluded from the purity determination.

The reason why zirconium and gas components are conventionally excluded from the impurity calculation is that zirconium and gas components in hafnium have not been considered important and can be tolerated. For example, as discussed above, the cited reference teaches to one of ordinary skill in the art that a large quantity of zirconium is contained in hafnium, that the separation and refinement between the two is difficult, and that the presence of zirconium "may be ***disregarded*** since the purpose of use of the respective materials ***will not hinder*** overall purpose hereof." Also, the cited reference teaches to one of ordinary skill in the art that it is "***extremely difficult to reduce Zr*** in high purity hafnium" and "the fact that Zr is mixed in high-purity hafnium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem***."

The same conventional sentiment is true for gas components, such as oxygen. Hafnium is an element that has a strong bond with oxygen, and the reduction of oxygen from hafnium is extremely difficult. Oxygen exists in hafnium in large quantities, not in trace amounts. By way of example, Table 4 shown on column 13 of the '030 Shindo patent (and Paragraph No. 0131 of the '261 Shindo published application) excludes gas components, such as carbon, oxygen and nitrogen, because according to conventional thinking, gas components are believed harmless even if in large quantities.

Electron beam melting described in the cited reference cannot reduce oxygen to levels required by the present application. For example, the present application discloses the use of electron beam melting to produce a hafnium ingot. The oxygen contents identified in Tables 1, 2 and 3 of the present application for Examples 1, 2 and 3 are 250wtppm, 400wtppm, and 100wtppm, respectively. Thereafter, the ingot was subject to deoxidation with molten salt. This produced the desired oxygen contents for Examples 1, 2 and 3 of less than 10wtppm, 20wtppm, and less than 10wtppm, respectively.

A reduction in oxygen content is one of the main objects and an important feature of the present invention. All claims of the present application require oxygen content of 40wtppm or less. New dependent claims 9, 14 and 19 require oxygen content of 10wtppm or less. No new matter was added, see Examples 1 and 3.

In comparison, the cited reference merely requires oxygen content to be 500wtppm or less. Oxygen content is not considered overly important since the raw material of the cited reference begins with an oxygen content of 500wtppm. Thus, this requires no reduction to be within the desired content. One example of the cited reference shows oxygen content reduced to 120wtppm. The other example does not even bother to list oxygen content. Accordingly,

Applicant respectfully submits that one of ordinary skill in the art following the teachings of the cited reference is not taught how to reduce oxygen content below 120wtppm and is not provided any common sense reason for limiting oxygen content to the reduced levels required by the claims of the present application.

Therefore, Applicant respectfully submits that claims 1, 2 and 7-19 of the present application are not obvious in view of the '030 Shindo patent or '261 Shindo published application. Applicant respectfully requests reconsideration of the disclosure of the cited reference and reconsideration and removal of the rejection.

(c) Zirconium Content

In the Office Action, it is stated that the '261 Shindo published application discloses that "zirconium would be present at levels of 0.5 weight percent or less (claim 7)".

Applicant respectfully submits that none of the 0.5wt% (5000wtppm), 3500wtppm (0.35wt%) and 2400wtppm (0.24wt%) zirconium contents disclosed by the '030 Shindo published application and the '261 Shindo published application discloses the reduced zirconium level of the claims of the present application, which require a zirconium content of 0.1wt% (1000wtppm) or less.

Further, the cited reference provides one of ordinary skill in the art with no common sense reason or motivation for reducing zirconium content below 0.5wt% (5000wtppm), 3500wtppm (0.35wt%) or 2400wtppm (0.24wt%). This is because one of ordinary skill in the art is taught by the cited reference that a large quantity of zirconium is contained in hafnium, that the separation and refinement between the two is difficult, and that the presence of zirconium "may be ***disregarded*** since the purpose of use of the respective materials ***will not hinder*** overall

purpose hereof." Also, the cited reference teaches to one of ordinary skill in the art that it is "***extremely difficult to reduce Zr*** in high purity hafnium" and "the fact that Zr is mixed in high-purity hafnium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem***."

The present invention of Shindo differs in this regard from the earlier cited patent and published application of Shindo cited in the Office Action. As stated above, conventional thinking is that zirconium content (such as 0.5wt%, 3500wtppm and 2400wtppm) can be "disregarded" since it "will not hinder" the overall purpose of the material and that it is too difficult to reduce zirconium content and there is no reason to reduce it because its presence "will not aggravate the properties of semiconductors, and will not be a problem." However, the present application recognizes that high residual resistance ratios cannot be provided by hafnium unless zirconium content (and oxygen, sulfur and phosphorus contents) is reduced to extreme levels. This is not disclosed in the cited reference, nor is the use of deoxidation with molten salt disclosed. New dependent claims 7, 8, 10, 12, 13, 15-17 and 19 have been added and recite these limitations. No new matter was added, see the present application, as filed, on page 3, lines 1-4; page 5, lines 21-26; and page 9, lines 5-15.

Accordingly, Applicant respectfully submits that claims 1, 2 and 7-19 of the present application are not obvious in view of the '030 Shindo patent or '261 Shindo published application. Applicant respectfully requests reconsideration of the disclosure of the cited reference and reconsideration and removal of the rejection.

B. *In the non-final Office Action of September 15, 2008, claims 1 and 2 are rejected under 35 USC §103(a) as being obvious over ASM Handbook Volume 2, pp. 1093-1097.*

In the Office Action, the ASM Handbook is stated as disclosing "(pg. 1094, col. 2) purifying metals such as hafnium to a purity approaching 99.999% by chemical vapor deposition ...".

Applicant respectfully disagrees with the sweeping significance given this thin disclosure provided by the ASM Handbook in the rejection. Applicant respectfully submits that page 1094 of the ASM Handbook merely describes the purities obtained in a chemical vapor deposition method as follows: 99.96% for titanium, 99.98% for zirconium ("plus hafnium, which is present at about the 200-ppm level"), and 99.995% for chromium. Further, the ASM Handbook merely discloses that hafnium is among a group of metals that can be purified to some level by a chemical vapor deposition method. It additionally describes that if the proper temperature is maintained, oxygen and other elements will be kept from flowing out in the vapor.

However, it is clear that the ASM Handbook fails to specifically disclose the zirconium content and oxygen content of a purified hafnium. Keep in mind that it is conventional practice to exclude zirconium and gas components, such as oxygen, from the purity calculation of hafnium. Furthermore, it is conventional knowledge that it is technologically difficult to eliminate zirconium content and oxygen content from hafnium. Accordingly, the ASM Handbook fails to make obvious to one of ordinary skill in the art a hafnium material having a zirconium content of 0.1wt% or less and oxygen content of 40wtppm or less as required by the claims of the present application.

All the reasons provided above with respect to the patentability of the claims of the present application over the '261 Shindo published application equally apply to the rejection

based on the ASM Handbook. One of ordinary skill in the art is provided with no knowledge, teachings or grounds for conceiving the invention required by the claims of the present application. Conventional teachings are that zirconium and oxygen content in hafnium can be "disregarded", "will not aggravate the properties of semiconductors", and "will not be a problem". There is no common sense reason for reducing these contents, and it is readily admitted in the prior art that it is extremely difficult to reduce such content.

Accordingly, Applicant respectfully submits that the ASM Handbook fails to describe in any way the zirconium content and oxygen content in purified hafnium. In addition, the method of refining hafnium of the present invention is entirely different to the method required by the ASM Handbook. One of ordinary skill in the art following the teachings of the ASM handbook would not be able to achieve the extremely reduced levels of zirconium and oxygen in hafnium and would have no reason for even trying.

Accordingly, Applicant respectfully submits that claims 1, 2 and 7-19 of the present application are not obvious in view of the ASM Handbook. Applicant respectfully requests reconsideration and removal of the rejection.

II. Claim Rejections – Double Patenting

A. In the Office Action, claims 1 and 2 are provisionally rejected on the ground of non-statutory obviousness-type double patenting as being unpatentable over claims 1 and 2 of co-pending application No 10/565,767.

A Terminal Disclaimer is being filed with respect to co-pending application No. 10/565,767. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection.

B. In the Office Action, claims 1 and 2 are provisionally rejected on the ground of non-statutory obviousness-type double patenting as being unpatentable over claims 1, 2, 4 and 10 of co-pending application No 11/994,167.

A Terminal Disclaimer is being filed with respect to co-pending application No. 11/994,167. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection.

III. Conclusion

In view of the above amendments, remarks, and Terminal Disclaimers, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

Respectfully submitted,
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